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FOR : Universal Work Holder Arrangement

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Assistant Commissioner for Patents
Washington, D. C. 20231

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Express Mail Label Number EI999403634US
Date of Deposit: June 22, 1998

The undersigned hereby certifies that this document, and its envlosures have been forwarded via Express Mail, postage prepaid mail to Box PATENT APPLICATION; Assistant Commissioner for Patents, Washington, D.C. 20231 on the date indicated..

Handwritten signature of Benita J. Rohm
BENITA J. ROHM, REG. NO. 28,664

TRANSMITTAL LETTER

SIR :

Enclosed herewith for filing is a U.S. utility patent application, in the name of inventor(s)
Richard E. Hurst and Mark A. Crongeyor including the following documents:

- 1) Specification with 18 pages, including Abstract and 24 claims (3 independent);
- 2) One (1) sheet(s) of drawings, 3 figures;
- 3) Declaration and Power of Attorney;
- 4) Verified Statement of Small Entity Status - Independent Inventor; and
- 5) Verified Statement of Small Entity Status - Small Business Concern.

The Commissioner is hereby authorized to charge \$439 for the filing fee, as well as any other
fee required, to Account No. 13-3406 in the name of Miller, Canfield Paddock and Stone, PLC

Respectfully submitted,

Handwritten signature of Benita J. Rohm

Dated: September 29, 1997

Benita J. Rohm
Reg. No. 28,664
Miller, Canfield, Paddock and Stone, P.L.C.
150 West Jefferson, Suite 2500
Detroit, Michigan 48226
(313) 963-6420

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APPLICATION FOR UNITED STATES LETTERS PATENT

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Universal Work Holder Arrangement

by

Richard E. Hurst

and

Mark A. Crongeyor

ROHM & MONSANTO, P.L.C.

Attorneys at Law

660 WOODWARD AVENUE, SUITE 1525

DETROIT, MICHIGAN 48226

TELEPHONE (313) 965-1976

TELECOPIER (313) 965-1951

Of Counsel:

Miller, Canfield, Paddock & Stone
150 West Jefferson, Suite 2500
Detroit, MI 48226-4415

Universal Work Holder Arrangement

Background of the Invention

FIELD OF THE INVENTION

This invention relates generally to arrangements for holding work pieces at predetermined or
5 convenient orientations, and more particularly, to an arrangement that allows simultaneous locking
in place and clamping of a work holder arrangement at a precise location and orientation, and with
multiple degrees of freedom with infinite resolution.

DESCRIPTION OF THE RELATED ART

Support arms for work holder arrangements are used in the prior art in various ways, such
10 as for preparing sheet metal parts for assembly or further production. Often, such arrangements are
employed with a holding arrangement that includes a suction cup, and are used to carry articles from
one production process to another, or to hold the articles during processing.

It is desired to provide a mounting bracket, or arm, that affords quick orientation and
clamping of the bracket into a desired position, while also permitting infinite resolution over multiple
15 degrees of freedom. Some prior art work holder arrangements achieve rapid clamping and setting
with a single fastener. These known brackets, however, achieve the clamping convenience at the
expense of degrees for freedom. For example, a known bracket that clamps and sets with a single
fastener provides neither axial extension of the bracket nor rotational positioning about the axis. This
known bracket, therefore, is not universal.

20 Similarly, a further known bracket that has endeavored to achieve the capacity for rotational
positioning about the axis requires that fixation be effected only at predetermined increments of
rotation. This known arrangement does not provide infinite rotational placement resolution, and
provides no axial extension whatsoever.

It is, therefore, an object of this invention to provide a mounting bracket arrangement for a
25 work piece in process that provides rotational and axial placement about the bracket axis.

It is another object of this invention to provide a mounting bracket arrangement for a work piece in process that provides infinite placement resolution in rotational and axial placement of the work piece with respect to the bracket axis.

It is also an object of this invention to provide a mounting bracket arrangement for a work piece in process that provides up to four degrees of freedom of placement of the workpiece with respect to a mounting structure.

Summary of the Invention

The foregoing and other objects are achieved by this invention which provides, in accordance with a first apparatus aspect thereof, a work holder arrangement for supporting a work article at a desired orientation with respect to a support structure. The work holder arrangement is provided with a first clamp member for coupling with the support structure, the first clamp member having clamped and unclamped states. There is additionally a second clamp member for coupling with the work article, the second clamp member having clamped and unclamped states. A tube portion is coupled to a selected one of the first and second clamp members, and a shaft portion is coupled to the other of the first and second clamp members. The shaft portion is accommodated coaxially within the tube portion. Additionally, there is provided an expansion portion arranged coaxially with the shaft portion within the tube portion. The invention further is provided with an elongated member for engaging with the expansion portion and for applying an axial force thereto. Thus, upon the application of the axial force, the expansion portion is urged transaxially against an interior surface of the tube portion, and the selected one of the first and second clamp members simultaneously is urged into the clamped state.

In one embodiment of the invention, the expansion portion is provided with a transverse ramp portion, and the shaft portion is terminated at an end portion thereof distal from the selected one of the first and second clamp members with a corresponding transverse ramp portion. In this manner, the transverse ramp portion of the expansion portion and the corresponding transverse ramp portion of the end portion of the shaft portion are arranged to communicate with each other. The expansion portion is engaged with the elongated member, and the axial force applied thereto is responsive to a displacement of the elongated member with respect to the expansion portion. Further in accordance with this embodiment of the invention, the communication between the transverse ramp portion of the expansion portion and the corresponding transverse ramp portion of the end portion of the shaft portion precludes rotation of the expansion portion as the elongated member is rotated.

Preferably, the shaft portion has a longitudinal bore therethrough for accommodating the elongated member. The longitudinal bore is axially arranged and dimensioned to accommodate a transaxial displacement of the elongated member, which occurs when the expansion portion is urged along the transverse ramp portion. In other embodiments, however, the elongated member is itself transaxially deformed, or flexed, to accommodate the transaxial displacement of the expansion portion as it is urged along the transverse ramp portion.

In a further embodiment of the invention, the shaft portion and the tube portion each have a circular cross-sectional configuration, whereby the expansion portion can be urged transaxially against an interior surface of the tube portion to fix the shaft portion at any axial location within the tube portion within a predetermined limit and at any rotational orientation between the shaft and tube portions. That is, the axial location of the shaft portion within the tube portion is adjustable with infinite resolution, as is the rotational orientation between these two portions.

UNITED STATES PATENT APPLICATION
Hurst and Crongeyor

5 In a practical application of the invention, the support structure is in the form of a support bar having a predetermined cross-sectional configuration. The first clamp member is configured to be rotatable about support bar, and slidable axially therealong, when the first clamp member is in the unclamped state. It is fixed axially and rotationally thereto when the first clamp member is in the clamped state.

10 In a still further embodiment of the invention, there is additionally provided a work article engagement arrangement having a predetermined configuration, and the second clamp member is correspondingly configured. The work article engagement arrangement is angularly displaceable when the second clamp member is in the unclamped state, and fixed angularly with respect thereto when the second clamp member is in the clamped state. In a practical embodiment, the work article engagement arrangement has a substantially spherical configuration and the second clamp member is correspondingly configured to have a concave configuration. The work article engagement arrangement in this embodiment is displaceable angularly with infinite resolution over a conical region. Alternatively, the work article engagement arrangement has a substantially cylindrical or somewhat concave (or apple-core-like) configuration and the second clamp member is correspondingly configured to have a substantially cylindrical internal configuration. In this substantially cylindrical embodiment of the invention, however, the work article engagement arrangement is not displaceable angularly.

15
20 In a highly advantageous embodiment of the invention, the first clamp member and the shaft portion are integrally formed with each other. The expansion portion has a cross-sectional configuration that corresponds to the cross-sectional configuration of the shaft portion. Similarly,

UNITED STATES PATENT APPLICATION
Hurst and Crongeyor

in this advantageous embodiment, the second clamp member and the tube portion are integrally formed with each other.

The axial force applied by the elongated member urges the first clamp portion and the expansion portion toward each other.

5 In accordance with a further apparatus aspect of the invention, there is provided a work holder support arm for supporting a work article at a desired orientation with respect to a support structure. The work holder arrangement is provided with a first clamp member having clamped and unclamped states for coupling with the support structure. The first clamp member has an opening
10 therethrough for accommodating the support structure, and through-hole arranged transverse to the opening. A shaft portion is coupled to the first clamp member, the shaft portion having a longitudinal bore therethrough arranged to be axially in registration with the through-hole of the first clamp member. Additionally, there is provided a second clamp member for coupling with the work article, the second clamp member having clamped and unclamped states. A tube portion is coupled to the second clamp member for accommodating telescopically therewithin the first shaft portion. An
15 expansion portion is arranged coaxially with the shaft portion within the tube portion, and is provided with a threaded section. An elongated member with a threaded portion for engaging with the threaded section of the expansion portion is provided for applying an axial force thereto. Upon the application of the axial force, the expansion portion is urged transaxially against an interior surface of the tube portion, and simultaneously the selected one of the first and second clamp members is
20 urged into the clamped state.

In one embodiment of this further aspect of the invention, the first clamp member and the shaft portion are integrally formed. Similarly, the second clamp member and the tube portion are integrally formed.

In a preferred embodiment, the expansion portion and the shaft portion have corresponding transverse ramps arranged to communicate with each other, whereby upon the application of the axial force, the expansion portion is urged along the transverse ramp of the shaft portion and substantially radially against an interior surface of the tube portion

As previously noted, a work article engagement arrangement has a predetermined configuration, and the second clamp member is correspondingly configured. Thus, the work article engagement arrangement is angularly displaceable when the second clamp member is in the unclamped state, and fixed angularly with respect thereto when the second clamp member is in the clamped state. The work article engagement arrangement is, in this embodiment, displaceable with infinite resolution over a conical region.

Brief Description of the Drawing

Comprehension of the invention is facilitated by reading the following detailed description, in conjunction with the annexed drawing, in which:

Fig. 1 is a plan view of a specific illustrative embodiment of the invention in the form of a work holder bracket;

Fig. 2 is a plan view of the mounting portion of the work holder bracket of Fig. 1 showing ramp portions that enable fixation thereof with respect to the other portion by means of transaxial displacement of an expansion portion; and

Fig. 3 is a side view of the embodiment of Fig. 1, further showing the arrangement by which an additional rotational and angular degree of placement freedom of the work piece is achieved.

Detailed Description

Fig. 1 is a plan view of a specific illustrative embodiment of the invention in the form of a work holder bracket 10. Work holder bracket 10 is formed of two major components, a shaft clamp that is generally designated as 11 and shown partially in phantom, and a tube clamp that is generally designated as 12.

Tube clamp 12, in this specific illustrative embodiment of the invention, has a tube portion 14 that has a first clamp subportion 15 installed thereon. In this embodiment, first clamp subportion 15 is integrally formed with tube portion 14. A second clamp subportion 16 is pivotally coupled at pivot 18 to first clamp subportion 15, and is forcefully urged thereto to effect a clamping by operation of a fastener 19. Other arrangements for effecting the clamping, such as toggle latches (not shown), can be used in the implementation of the invention.

Fig. 2 is a plan view of the mounting portion of the work holder bracket 10 of Fig. 1 showing shaft clamp 11 in greater detail. As shown, shaft clamp 11 has a clamp portion 20 having an aperture 21 therethrough. This aperture, in the practice of the invention, will accommodate a mounting bar (not shown) associated with a mounting structure (not shown). Clamp portion 20 appears to wrap around aperture 21 so as to have two leg portions 24 and 25. A further aperture 26 is arranged at the end of clamp portion 20, and directed in a direction orthogonal to aperture 21.

Leg portion 24 is coupled to a shaft portion 27. In a preferred embodiment, these elements are fixed to one another by integral formation, weldment (not shown), threaded coupling (not shown),

or otherwise. Shaft portion 27 has an axial bore 28 therethrough that is in axial registration with aperture 26 that begins on leg portion 25.

There is additionally shown in this figure an expansion portion 30 having an internally threaded portion 31. Expansion portion 30 has a transaxial ramp portion 34 that is arranged to communicate with a corresponding ramp portion 35 at the end of tube portion 27 distal from clamp portion 20. An elongated member 37 having a head 38 and a distal threaded portion 39 is configured to be accommodated into aperture 26 and to extend along axial bore 28 of tube portion 27. Threaded portion 39 of the elongated member is configured to engage threadedly with internally threaded portion 31 of expansion portion 30. Thus, as elongated member 37 is rotated in a tightening direction, expansion portion 30 is urged transaxially along the interface of ramp portions 34 and 35, placing a radial force against the inner surface of tube portion 14. Thus, the respective ramp portions enable fixation of the shaft portion within the tube portion at any axial location, within the predetermined limits of their respective lengths, and at any rotational orientation with respect thereto. Infinite placement resolution is thereby achieved.

Rotation of expansion portion 30 with the rotation of elongated member 37 is precluded by the interface of ramp portion 34 and 35. Also, it is seen that as expansion portion 30 is urged transaxially along the ramp portions, elongated member 37 is similarly transaxially displaced. Thus, axial bore 28 of shaft portion 27 must be configured with a diameter sufficient to accommodate the transaxial displacement of the elongated member.

Fig. 3 is a side view of the embodiment of Fig. 1, further showing the arrangement by which an additional rotational and angular degree of placement freedom of the work piece is achieved. Elements of structure that previously have been discussed are similarly designated. In some

embodiments of the invention, a substantially spherical work holder element 40 is provided, having a work holder shaft 41 coupled thereto. First and second subclamp portions 15 and 16 (not specifically designated in this figure) have substantially spherically contoured internal surfaces 43 that will engage with the substantially spherical outer surface of work holder element 40. When work holder element 40 is engaged with contoured internal surfaces 43, work holder shaft 41 is rotationally movable, as well as angularly movable, as indicated by arrow 45. Tightening of fastener 19 will fix the work holder element at any desired orientation within the first and second subclamp portions 15 and 16, respectively.

The present invention therefore provides a mounting arrangement that affords the following degrees of freedom, each with infinite placement resolution:

- rotation of clamp portion 20 about the mounting bar (not shown);
- axial displacement between shaft clamp 11 and tube clamp12;and
- axial rotation between shaft clamp 11 and tube clamp12.

In some embodiments of the invention, there are provided the additional degrees of freedom with infinite resolution of:

- rotation of work holder shaft 41 with respect to shaft clamp 11 and tube clamp12; and
- angular displacement of work holder shaft 41 with respect to shaft clamp 11 and tube clamp12.

Although the invention has been described in terms of specific embodiments and applications, persons skilled in the art can, in light of this teaching, generate additional embodiments without exceeding the scope or departing from the spirit of the claimed invention. Accordingly, it is to be

Hurst and Crongeyor

understood that the drawing and description in this disclosure are proffered to facilitate comprehension of the invention, and should not be construed to limit the scope thereof.

[illegible]

What is claimed is:

1. A work holder arrangement for supporting a work article at a desired orientation with respect to a support structure, the work holder arrangement comprising:

a first clamp member for coupling with the support structure, said first clamp member having clamped and unclamped states;

a second clamp member for coupling with the work article, said second clamp member having clamped and unclamped states;

a tube portion coupled to a selected one of said first and second clamp members;

a shaft portion coupled to the other of said first and second clamp members, said shaft portion being accommodated coaxially within said tube portion;

an expansion portion arranged coaxially with said shaft portion within said tube portion; and

elongated means for engaging with said expansion portion and applying an axial force thereto, whereby upon the application of the axial force, said expansion portion is urged transaxially against an interior surface of said tube portion, and the selected one of said first and second clamp members simultaneously is urged into the clamped state.

2. The work holder arrangement of claim 1, wherein said expansion portion comprises a transverse ramp portion, and said shaft portion is terminated at an end portion thereof distal from the selected one of said first and second clamp members with a corresponding transverse ramp portion, wherein the transverse ramp portion of said expansion portion and said corresponding transverse ramp portion of the end portion of said shaft portion are arranged to communicate with each other.

3. The work holder arrangement of claim 2, wherein said expansion portion is engaged with said elongated means, and the axial force applied thereto is responsive to a displacement of said elongated means with respect to said expansion portion.

4. The work holder arrangement of claim 3, wherein the communication between the transverse ramp portion of said expansion portion and said corresponding transverse ramp portion of the end portion of said shaft portion precludes rotation of said expansion portion as said elongated means is rotated.

5. The work holder arrangement of claim 1, wherein said shaft portion has a longitudinal bore therethrough for accommodating said elongated means.

6. The work holder arrangement of claim 5, wherein said longitudinal bore is axially arranged and dimensioned to accommodate a transaxial displacement of said elongated means.

7. The work holder arrangement of claim 1, wherein said shaft portion and said tube portion each have a circular cross-sectional configuration, whereby said expansion portion can be urged transaxially against an interior surface of said tube portion to fix said shaft portion at any axial location within said tube portion within a predetermined limit and at any rotational orientation between said shaft and tube portions.

8. The work holder arrangement of claim 1, wherein the support structure is a support bar having a predetermined cross-sectional configuration, and said first clamp member is configured to be rotatable about, and slidable axially therealong, said support bar when said first clamp member is in the unclamped state, and fixed axially and rotationally thereto when said first clamp member is in the clamped state.

UNITED STATES PATENT APPLICATION
Hurst and Crongeyor

9. The work holder arrangement of claim 1, wherein there is further provided a work
article engagement arrangement having a predetermined configuration, and said second clamp
member is correspondingly configured, whereby said work article engagement arrangement is
angularly displaceable when said second clamp member is in the unclamped state, and fixed angularly
with respect thereto when said second clamp member is in the clamped state.

10. The work holder arrangement of claim 9, wherein said work article engagement
arrangement has a substantially spherical configuration and said second clamp member is
correspondingly configured to have a concave configuration.

11. The work holder arrangement of claim 9, wherein said work article engagement
arrangement has a substantially concave configuration and said second clamp member is
correspondingly configured to have a substantially cylindrical internal configuration.

12. The work holder arrangement of claim 1, wherein said first clamp member and said
shaft portion are integrally formed with each other.

13. The work holder arrangement of claim 12, wherein said expansion portion has a cross-
sectional configuration that corresponds to the cross-sectional configuration of said shaft portion.

14. The work holder arrangement of claim 1, wherein the axial force applied by said
elongated means urges said first clamp portion and said expansion portion toward each other.

15. The work holder arrangement of claim 1, wherein said second clamp member and said
tube portion are integrally formed with each other.

16. A work holder support arm for supporting a work article at a desired orientation with
2 respect to a support structure, the work holder arrangement comprising:

4 a first clamp member having clamped and unclamped states for coupling with the support
structure, said first clamp member having an opening therethrough for accommodating the support
structure, and further having a through-hole arranged transverse to the opening;

6 a shaft portion coupled to said first clamp member, said shaft portion having a longitudinal
bore therethrough, the longitudinal bore being arranged to be axially in registration with the through-
8 hole of said first clamp member;

10 a second clamp member for coupling with the work article, said second clamp member having
clamped and unclamped states;

12 a tube portion coupled to said second clamp member for accommodating telescopically
therewithin said shaft portion;

14 an expansion portion arranged coaxially with said shaft portion within said tube portion, said
expansion portion having a threaded section; and

16 elongated means having a threaded portion for engaging with the threaded section of said
expansion portion and applying an axial force thereto, whereby upon the application of the axial force,
said expansion portion is urged transaxially against an interior surface of said tube portion, and the
18 selected one of said first and second clamp members simultaneously is urged into the clamped state.

20 17. The work holder support art of claim 16, wherein said first clamp member and said
shaft portion are integrally formed.

22 18. The work holder support art of claim 16, wherein said second clamp member and said
tube portion are integrally formed.

UNITED STATES PATENT APPLICATION

Hurst and Crongeyor

19. The work holder support art of claim 16, wherein said expansion portion and said shaft
portion have corresponding transverse ramps arranged to communicate with each other, whereby
upon the application of the axial force, said expansion portion is urged along the transverse ramp of
said shaft portion and substantially radially against an interior surface of said tube portion

20. The work holder support art of claim 16, wherein there is further provided a work
article engagement arrangement having a predetermined configuration, and said second clamp
member is correspondingly configured, whereby said work article engagement arrangement is
angularly displaceable when said second clamp member is in the unclamped state, and fixed angularly
with respect thereto when said second clamp member is in the clamped state.

21. A work holder support arm for supporting a work article at a desired orientation with
2 respect to a support structure, the work holder arrangement comprising:

4 a first clamp member having open and clamped states for coupling with the support structure,
said first clamp member being installable on, and movable with respect to, the support structure when
said first clamp member is in the open state;

6 a second clamp member for coupling with the work article, said second clamp member having
clamped and unclamped states;

8 a shaft portion coupled to a selectable one of said first and second clamp members, said shaft
portion having a longitudinal bore therethrough;

10 a tube portion coupled to the other of said first and second clamp members for
accommodating telescopically therewithin said shaft portion;

12 an expansion portion arranged coaxially with said shaft portion within said tube portion, said
expansion portion having a threaded section; and

14 elongated means having a threaded portion for engaging with the threaded section of said
expansion portion and applying an axial force thereto, whereby upon the application of the axial force,
16 said expansion portion is urged transaxially against an interior surface of said tube portion, and the
selected one of said first and second clamp members simultaneously is urged into the clamped state.

18 22. The work holder support arm of claim 21, wherein said first clamp member is coupled
to said shaft portion and said second clamp member is coupled to said tube portion.

UNITED STATES PATENT APPLICATION
Hurst and Crongeyor

23. The work holder support arm of claim 21, wherein said first clamp member is provided
2 with:

a hinged portion that is pivotally rotatable about a hinge when said first clamp member is in
4 the open state; and

a locking element for urging said hinged portion forcefully into a closed condition,
6 corresponding to the clamped state of said first clamp member.

24. The work holder support arm of claim 23, wherein said locking element comprises a
8 threaded fastener.

ABSTRACT OF THE DISCLOSURE

A work holder support arm for supporting a work article at a desired orientation with respect to a support structure is provided with a first clamp having clamped and unclamped states for coupling with the support structure. The first clamp has an opening therethrough for accommodating the support structure, and there may be provided a through-hole arranged transverse to the opening. A shaft portion is coupled to the first clamp, the shaft portion having a longitudinal bore therethrough arranged to be axially in registration with the through-hole of the first clamp . Additionally, a second clamp couples with the work article and has clamped and unclamped states. A tube portion is coupled to the second clamp for accommodating telescopically therewithin the first shaft portion. An expansion portion is arranged coaxially with the shaft portion within the tube portion, and is provided with a threaded section. The expansion portion and the shaft portion have corresponding transverse ramps arranged to communicate with each other. An elongated element with a threaded portion for engaging with the threaded section of the expansion portion applies an axial force thereto which causes the expansion portion to be urged transaxially against an interior surface of the tube portion. Simultaneously, the first clamp is urged into the clamped state. The first clamp and the shaft portion preferably are integrally formed, as are the second clamp and the tube portion.

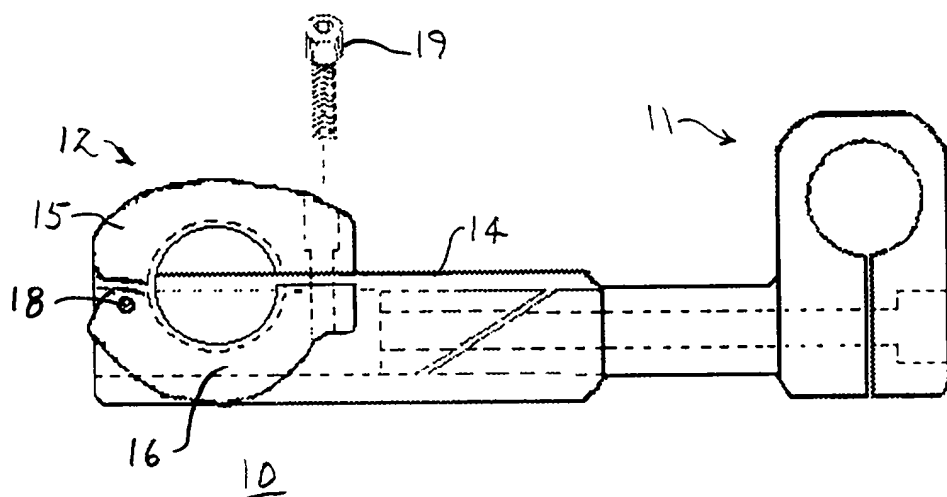


FIG. 1

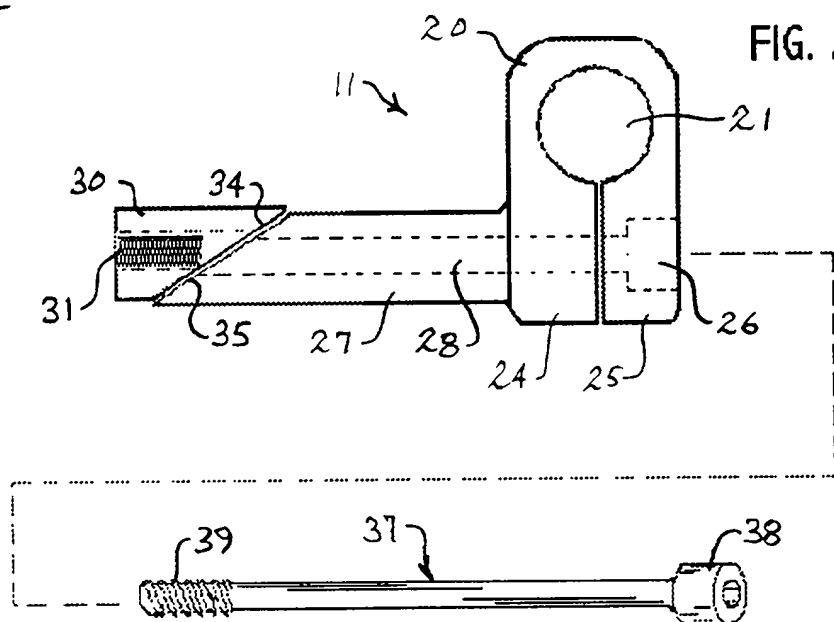


FIG. 2

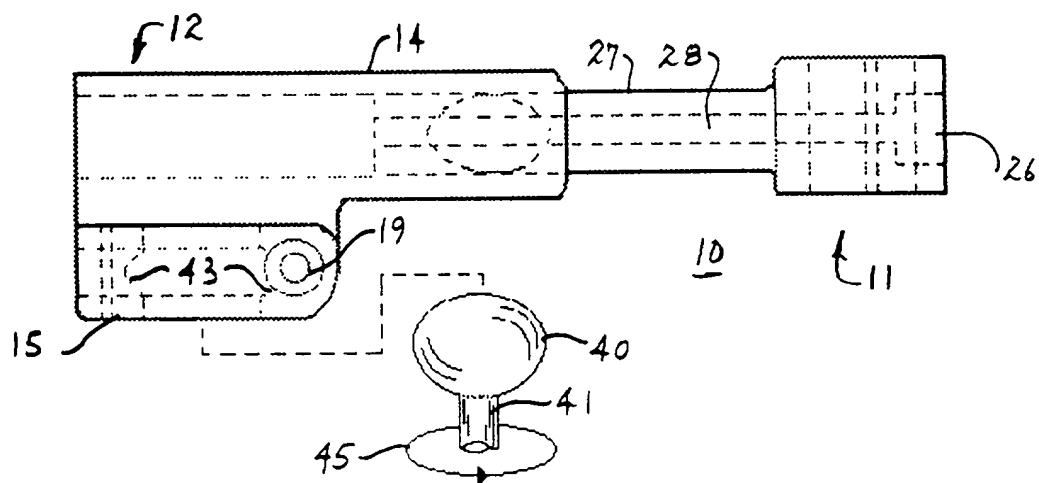


Fig. 3

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Universal Work Holder Arrangement

the specification of which:

CHECK ONE

☒ (X) is attached hereto

☐ () was filed on:

Application Serial Number.

Preliminary Amendment filed on _____ (if applicable).

☐ () was filed as PCT International Application

Number:

Filed :

and was amended under PCT Article 19 _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application on which priority is claimed:

**DECLARATION AND POWER-OF-ATTORNEY
FOR PATENT APPLICATION
Page 2**

PRIOR FOREIGN APPLICATION(S)

PRIORITY CLAIMED

_____	_____	_____	_____	Yes	No
Country	Application No.	Filed	Issued		
_____	_____	_____	_____	Yes	No
Country	Application No.	Filed	Issued		

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose the material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

**PRIOR U.S. APPLICATIONS:
APPLICATION SERIAL NO.**

DATE OF FILING

STATUS

/ /

PCT APPLICATIONS DESIGNATING THE U.S.:

PCT APPN. NO.

PCT FILING DATE

US SERIAL NO.

STATUS

/ / /

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Title 18 of the United States Code §1001, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

00405010-062299

**DECLARATION AND POWER-OF-ATTORNEY
FOR PATENT APPLICATION
Page 3**

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (list name and registration number):

Marjorie G. Basile, Reg. No. 28,181
Richard A. Gaffin, Reg. No. 28,949
Raphael A. Monsanto, Reg. No. 28,448
Benita J. Rohm, Reg. No. 28,664

SEND CORRESPONDENCE TO:

Raphael A. Monsanto, Esq.
Miller, Canfield, Paddock and Stone, P.L.C.
150 West Jefferson, Suite 2500
Detroit, MI 48226-4415

DIRECT TELEPHONE CALLS TO:

Raphael A. Monsanto, Esq.
(313) 496-7676

Full name of sole or first inventor: **Richard E. Hurst**

Inventor's Signature: *Richard E. Hurst* Date: 6/22/98

Residence: Troy, Michigan Citizenship: U.S.A

Post Office Address: c/o Erie Automation Company, 14001 E. 14 Mile Road, Troy, MI 48084

Full name of joint or second inventor: **Mark A. Crongeyer^{MAL}**

Inventor's Signature: *Mark A. Crongeyer* Date: 6-22-98

Residence: Troy, Michigan Citizenship: U.S.A

Post Office Address:

Full name of joint or third inventor:

Inventor's Signature: _____ Date: _____

Residence: _____ Citizenship: _____

Post Office Address:

Ends 1988

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS
(37 CFR §1.9(f) and §1.27(b)) - INDEPENDENT INVENTOR**

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR §1.9(c) for purposes of paying reduced fees under §41(a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled

Universal Work Holder Arrangement

as described in

☒ (X) the specification filed herewith

☐ () application Serial No.:

Filed:

☐ () Patent No. _____

Issued _____

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR §1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR §1.9(d) or a nonprofit organization under 37 CFR §1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

☐ () no such person, concern, or organization

☒ (X) persons, concerns or organizations listed below*

***NOTE:** Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR §1.27)

FULL NAME:

Erie Automation Company

☐ () Individual

ADDRESS:

14001 E. 14 Mile Road
Troy, MI 48084

☒ (X) Small Business Concern

☐ () Non-Profit Organization

FULL NAME:

☐ () Individual

ADDRESS:

☐ () Small Business Concern

☐ () Non-Profit Organization

Verified Statement - Independent Inventor**Page 2**

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR §1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Richard E. Hurst


SIGNATURE

6/22/98
DATE

Mark A. Crongever^{MAC}


SIGNATURE

6-22-98
DATE

fmh:mee

000000-01500000

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS
(37 CFR §1.9(f) and §1.27(c) - SMALL BUSINESS CONCERN**

I hereby declare that I am an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF CONCERN: **Erie Automation Company**
ADDRESS OF CONCERN: **14001 E. 14 Mile Road**
Troy, MI 48084

I hereby declare that the above-identified small business concern qualifies as a small business concern as defined in 13 CFR §121.3-18, and reproduced in 37 CFR §1.9(d), for purposes of paying reduced fees under §41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract of law have been conveyed to the remain with the small business concern identified above with regard to the invention, entitled

Universal Work Holder Arrangement

by inventor(s) **Richard E. Hurst and Mark A. Crongeyor** described in

☒ (X) the specification filed herewith

☐ () application Serial No.:

Filed:

☐ () Patent No. _____

Issued _____

If the rights held by the above-identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who could not qualify as a small business concern under 37 CFR §1.9(d) or by any concern which would not qualify as a small business concern under 37 CFR §1.9(d) or a nonprofit organization under 37 CFR §1.9(e). *NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR §1.27)

NAME: _____

☒ (X) Individual

ADDRESS: _____

☐ () Small Business Concern

☐ () Nonprofit Organization

NAME: _____

☒ (X) Individual

ADDRESS: _____

☐ () Small Business Concern

☐ () Nonprofit Organization

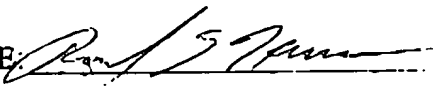
602290-6122400

Verified Statement - Small Business Concern**Page 2**

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR §1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING : **Richard E. Hurst**
TITLE IN ORGANIZATION : **General Manager**
ADDRESS OF PERSON SIGNING: **Erie Automation Company**
14001 E. 14 Mile Road
Troy, MI 48064

SIGNATURE:  DATE: 6/22/98

File name